**M2p.65xx-x4 - 16 bit 125 MS/s Arbitrary Waveform Generator**

- Up to 125 MS/s on four channels
- Up to 80 MS/s on eight channels
- One, two, four and eight channel versions
- Versions with 40 MS/s and 125 MS/s
- Ultra Fast PCI Express x4 interface
- Simultaneous signal generation on all channels
- Output level max. ±3 V into 50 Ohm (±6 V into 1 MOhm)
- Features: Single-Shot, Loop, FIFO, Gated Replay, Sequence Replay
- 512 MSamples on-board memory
- Synchronization of up to 16 cards per system
- Fixed trigger to output delay
- Direct data transfer from CUDA GPU using SCAPP option

**Operating Systems**
- Windows 7 (SP1), 8, 10, Server 2008 R2 and newer
- Linux Kernel 2.6, 3.x, 4.x, 5.x
- Windows/Linux 32 and 64 bit

**Recommended Software**
- Visual C++, Delphi, C++ Builder, GNU C++, VB.NET, C#, Java, Python
- SBench 6

**Drivers**
- MATLAB
- LabVIEW
- LabWindows/CVI
- IVI

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<table>
<thead>
<tr>
<th>Model</th>
<th>Analog output channels</th>
<th>Output Level in 50 Ω</th>
<th>in 1 MΩ</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2p.6530-x4</td>
<td>1ch: 40 MS/s; 2ch: 40 MS/s; 4ch: 40 MS/s</td>
<td>±3 V</td>
<td>±6 V</td>
</tr>
<tr>
<td>M2p.6531-x4</td>
<td>2ch: 40 MS/s; 4ch: 40 MS/s</td>
<td>±3 V</td>
<td>±6 V</td>
</tr>
<tr>
<td>M2p.6536-x4</td>
<td>2ch: 40 MS/s; 4ch: 40 MS/s</td>
<td>±3 V</td>
<td>±6 V</td>
</tr>
<tr>
<td>M2p.6533-x4</td>
<td>1ch: 40 MS/s; 2ch: 40 MS/s; 4ch: 40 MS/s</td>
<td>±3 V</td>
<td>±6 V</td>
</tr>
<tr>
<td>M2p.6550-x4</td>
<td>125 MS/s</td>
<td>±3 V</td>
<td>±6 V</td>
</tr>
<tr>
<td>M2p.6561-x4</td>
<td>125 MS/s; 125 MS/s</td>
<td>±3 V</td>
<td>±6 V</td>
</tr>
<tr>
<td>M2p.6566-x4</td>
<td>125 MS/s; 125 MS/s</td>
<td>±3 V</td>
<td>±6 V</td>
</tr>
<tr>
<td>M2p.6568-x4</td>
<td>125 MS/s; 125 MS/s; 125 MS/s</td>
<td>±3 V</td>
<td>±6 V</td>
</tr>
</tbody>
</table>

**General Information**
The M2p.65xx series offers different versions of arbitrary waveform generators for PCI Express with a maximum output rate of 125 MS/s. These boards allow to generate freely definable waveforms on several channels synchronously.

With one of the synchronization options the setup of synchronous multi channel systems is possible as well as the combination of arbitrary waveform generators with digitizers of the M2p product family.

The 512 MSample on-board memory can be used as arbitrary waveform storage or as a FIFO buffer continuously streaming data via the PCIe interface.

The high-resolution 16-bit DACs deliver four times the resolution of AWGs using 1.4-bit technology.

*Some x16 PCIe slots are for the use of graphic cards only and can’t be used for other cards.** Throughput measured with a motherboard chipset supporting a TLP size of 256 bytes.
Software Support

Windows drivers
The cards are delivered with drivers for Windows 7, Windows 8 and Windows 10 (each 32 bit and 64 bit). Programming examples for Visual C++, C# Builder, LabWindows/CVI, Delphi, Visual Basic, VB.NET, C#, J#, Python, Java and IVI are included.

Linux drivers
All cards are delivered with full Linux support. Pre compiled kernel modules are included for the most common distributions like Fedora, Suse, Ubuntu LTS or Debian. The Linux support includes SMP systems, 32 bit and 64 bit systems, versatile programming examples for GNU C++, Python as well as the possibility to get the driver sources for your own compilation.

SBench 6
A base license of SBench 6, the easy-to-use graphical operating software for Spectrum cards, is included in the delivery. The base license makes it possible to test the card, generate simple signals or load and replay previously stored SBench 6 signals. It's a valuable tool for checking the cards performance and assisting with the units initial setup. The cards also come with a demo license for the SBench6 professional version. This license gives the user the opportunity to test the additional features of the professional version with their hardware. The professional version contains several advanced measurement functions, such as FFTs and X/Y display, import and export utilities as well as support for all replay modes, including data streaming. Data streaming allows the cards to continuously replay data and transfer it directly from the PC RAM or hard disk. SBench 6 has been optimized to handle data files of several GBytes. SBench 6 runs under Windows as well as Linux (KDE and GNOME) operating systems. A test version of SBench 6 can be downloaded directly over the internet and can run the professional version in a simulation mode without any hardware installed. Existing customers can also request a demo license for the professional version from Spectrum. More details on SBench 6 can be found in the SBench 6 data sheet.

SCAPP – CUDA GPU based data processing
For applications requiring high powered signal and data processing Spectrum offers SCAPP (Spectrum’s CUDA Access for Parallel Processing). The SCAPP SDK allows a direct link between Spectrum digitizers, AWGs or Digital Data Acquisition Cards and CUDA based GPU cards. Once in the GPU users can harness the processing power of the GPU’s multiple (up to 5000) processing cores and large (up to 24 GB) memories. SCAPP uses an RDMA (Linux only) process to send data at the full PCIe transfer speed to and from the GPU card. The SDK includes a set of examples for interaction between the Spectrum card and the GPU card and another set of CUDA parallel processing examples with easy building blocks for basic functions like filtering, averaging, data de-multiplexing, data conversion or FFT. All the software is based on C/C++ and can easily be implemented, expanded and modified with normal programming skills.

Third-party products
Spectrum supports the most popular third-party software products such as LabVIEW, MATLAB or LabWindows/CVI. All drivers come with detailed documentation and working examples are included in the delivery. Support for other software packages, like VEE or DasyLab, can also be provided on request.

Hardware features and options
PCI Express x4
The M2p series cards use a PCI Express x4 Gen 1 connection. They can be used in PCI Express x4, x8 and x16 slots with hosts supporting Gen 1, Gen 2 or Gen 3. The maximum sustained data transfer rate is more than 700 MByte/s (read direction) or 700 MByte/s (write direction) per slot. Physically supported slots that are electrically connected with only x1 or x2 can also be used with the M2p series cards, but with reduced data transfer rates.

Connections
The cards are equipped with SMB connectors for the analog signals as well as for the external trigger and clock input. In addition, there are four MMCX connectors: one multi-function output (X0) and three multi-function I/O connectors (X1, X2, X3). These multi-function connectors can be individually programmed to perform different functions:

- Clock output (X0 only)
- Trigger output
- Status output (armed, triggered, ready, …)
- Synchronous digital inputs, being stored inside the analog data samples
- Asynchronous I/O lines
- Logic trigger inputs

Single shot output
When single shot output is activated the data of the on-board memory is played exactly one time. The trigger source can be either one of the external trigger inputs or the software trigger. After the first trigger additional trigger events will be ignored.

Repeated output
When the repeated output mode is used the data of the on-board memory is played continuously for a programmed number of times or until a stop command is executed. The trigger source can be either one of the external trigger inputs or the software trigger. After the first trigger additional trigger events will be ignored.

Single Restart replay
When this mode is activated the data of the on-board memory will be replayed once after each trigger event. The trigger source can be either the external TTL trigger or software trigger.

FIFO mode
The FIFO or streaming mode is designed for continuous data transfer between the card and the PC memory. When mounted in a PCI Express x4 Gen 1 interface read streaming speeds of up to 700 MByte/s are possible. The control of the data stream is done automatically by the driver on interrupt request basis. The complete installed onboard memory is used to buffer the data, making the continuous streaming process extremely reliable.
Multiple Replay

The Multiple Replay mode allows the fast output generation on several trigger events without restarting the hardware. With this option very fast repetition rates can be achieved. The on-board memory is divided into several segments of the same size. Each segment can contain different data which will then be played with the occurrence of each trigger event.

Gated Replay

The Gated Sampling mode allows data replay controlled by an external gate signal. Data is only replayed if the gate signal has attained a programmed level.

Sequence Mode

The sequence mode allows to split the card memory into several data segments of different length. These data segments are chained up in a user chosen order using an additional sequence memory. In this sequence memory the number of loops for each segment can be programmed and trigger conditions can be defined to proceed from segment to segment. Using the sequence mode it is also possible to switch between replay waveforms by a simple software command or to redefine waveform data for segments simultaneously while other segments are being replayed. All trigger-related and software-command-related functions are only working on single cards, not on star-hub-synchronized cards.

External trigger input

All boards can be triggered using an external analog or digital signal. The external trigger input has one comparator that can be used for standard edge and level triggers.

External clock input and output

Using a dedicated connector a sampling clock can be fed in from an external system. Additionally it’s also possible to output the internally used sampling clock on a separate connector to synchronize external equipment to this clock.

Reference clock

The option to use a precise external reference clock (typically 10 MHz) is necessary to synchronize the instrument for high-quality measurements with external equipment (like a signal source). It’s also possible to enhance the stability of the sampling clock in this way. The driver automatically generates the requested sampling clock from the fed in reference clock.

Star-Hub

The Star-Hub is an additional module allowing the phase stable synchronization of up to 16 boards in one system. Two versions are available: one with up to 6 cards and the large version supports up to 16 cards in one system. Both versions can be mounted in two different ways, to either extend the cards length to ¾ PCIe length occupying one slot, or extend its width to two slots whilst keeping the ½ PCIe length.
**Technical Data**

**Analog Outputs**

- **Resolution**: 16 bit
- **D/A Interpolation**: no interpolation
- **Output amplitude**
  - software programmable: ±1 mV to ±3 V in 1 mV steps into 50 Ω termination
  - (resulting in ±2 mV up to ±6 V in 2 mV steps into high impedance loads)

  Note: Gain values below ±300 mV into 50 Ω are reduced by digital scaling of the samples

- **Output Amplifier Path Selection**
  - automatically by driver
  - **Low Power path**: Selected Gain of ±1 mV to ±960 mV (into 50 Ω)
  - **High Power path**: Selected Gain of ±940 mV to ±3 V (into 50 Ω)

- **Output Amplifier Setting Hysteresis**
  - automatically by driver
  - 940 mV to 960 mV (if output is using low power path it will switch to high power path at 960 mV. If output is using high power path it will switch to low power path at 940 mV)

- **Output amplifier path switching time**: 1.2 ms (output disabled while switching)

- **Output offset**
  - software programmable
  - **Low Power path**: ±960 mV in 1 mV steps into 50 Ω (±1920 mV in 2 mV steps into high-Z)
  - **High Power path**: ±3 V in 1 mV steps into 50 Ω (±6 V in 2 mV steps into high-Z)

- **Filters**
  - software programmable
  - One of 4 different filters (refer to „Bandwidth and Filters” section)

- **DAC Differential non linearity (DNL)**
  - DAC only: ±2.0 LSB typical

- **DAC Integral non linearity (INL)**
  - DAC only: ±4.0 LSB typical

- **Output resistance**: 50 Ω

- **Minimum output load**: 0 Ω (short circuit safe)

- **Max output swing in 50 Ω**: ±3.0 V (offset + amplitude)

- **Max output swing in 1 MΩ**: ±6.0 V (offset + amplitude)

- **Slewrate (using Filter 0)**
  - Low power path (0 to 900 mV): 250 mV/ns
  - High power path (0 to 3000 mV): 850 mV/ns

- **Crosstalk @ 1 MHz signal ±3 V**
  - 1 to 4 channel AWG: 95 dB
  - 8 channel AWG: 84 dB

- **Output accuracy**
  - **Low Power path**: ±TBD mV ±TBD % of programmed output amplitude
  - **High Power path**: ±TBD mV ±TBD % of programmed output amplitude

**Trigger**

- **Available trigger modes**
  - software programmable: External, Software, Pulse, Re-Arm, Or/And, Delay

- **Trigger edge**
  - software programmable: Rising edge, falling edge or both edges

- **Trigger pulse width**
  - software programmable: 0 to [4G - 1] samples in steps of 1 sample

- **External trigger type**
  - software programmable: Single level comparator

- **External trigger impedance**
  - software programmable: 50 Ω / 5 kΩ

- **External trigger over voltage protection**
  - ±5 V (5 kΩ), ±2.5 V (50 Ω), ±20 V (5 kΩ), ±50 V (50 Ω)

- **External trigger sensitivity**
  - software programmable: 200 mVpp

- **Minimum external trigger pulse width**
  - ≥ 2 samples

**Multi Purpose I/O lines**

- **Number of multi purpose output lines**: one, named X0
- **Number of multi purpose input/output lines**: three, named X1, X2, X3

- **Multiple Replay segment size**: 8 up [installed memory / number of active channels] samples in steps of 8

- **External trigger accuracy**: Ext

- **Input: available signal types**
  - software programmable: Asynchronous Digital-In, Logic trigger

- **Input: signal levels**
  - n.a.: 3.3 V (LVTTL)

- **Input: impedance**
  - n.a.: 10 kΩ to 3.3 V

- **Input: maximum voltage level**
  - n.a.: ±0.5 V to ±4.0 V

- **Input: maximum bandwidth**
  - n.a.: 125 MHz

- **Output: available signal types**
  - software programmable: Run-, Arre-, Trigger-Output, Marker-Output, Synchronous Digital-Out, Asynchronous Digital-Out, ADC Clock Output

- **Output: drive strength**: Capable of driving 50 Ω loads, maximum drive strength ±48 mA

- **Output: type / signal levels**
  - 3.3V (LVTTL) compatible for high impedance loads

- **Output: update rate (synchronous modes)**
  - sampling clock
**Option M2p.xxxx-DigFX2**

- **Number of additional multi-purpose I/O lines:** 16
- **Multi Purpose functionality:** software programmable
- **Card width with installed option:** 2 slots
- **Connector:** 1 x Hirose FX/2 (one adapter cable to IDC connector included)
- **Compatibility:** Pinning compatible with M2i.xxxx-dig option and M2i.70xx connectors

**Sequence Replay Mode**

- **Number of sequence steps:** software programmable up to 4096 (sequence steps can be overloaded at runtime)
- **Number of memory segments:** software programmable up to 32 segments in steps of 8 samples
- **Maximum segment size:** software programmable 512 MS / active channels / number of sequence segments (round up to the next power of two)
- **Loop Count:** software programmable 1 to (1M - 1) loops
- **Sequence Step Commands:** software programmable Loop for #Loops, Next, Loop until Trigger, End Sequence
- **Special Commands:** software programmable Data Overload at runtime, sequence steps overload at runtime,
- **Limitations for synchronized products:** Software commands changing the sequence as well as „Loop until trigger“ are not synchronized between cards. This also applies to multiple AWG modules in a generatorNETBOX.

**Clock**

- **Clock Modes:** software programmable internal PLL, external clock, external reference clock, sync
- **Internal clock range (PLL mode):** see „Clock Limitations“ table below
- **Internal clock accuracy after warm-up:** ±1.0 ppm (at time of calibration in production)
- **Internal clock aging:** ±0.5 ppm / year
- **External reference clock range:** software programmable 128 kHz up to 125 MHz
- **Direct external clock to internal clock delay:** 4.3 ns
- **Direct external clock range:** see „Clock Limitations and Bandwidth“ table below
- **External clock type:** Single level comparator
- **External clock input level:** ±5 V (5 kΩ), ±2.5 V (50 kΩ)
- **External clock over voltage protection:** ±20 V (5 kΩ), 5 Vrms (50 kΩ)
- **External clock sensitivity (minimum required signal swing):** 200 mVpp
- **External clock rise time:** 5 V in steps of 1 mV
- **External clock edge:** rising edge used
- **External reference clock input duty cycle:** 45% - 55%
- **Clock output electrical specification:** Available via Multi Purpose output X0. Refer to „Multi Purpose I/O lines“ section.
- **Channel to channel skew on one card:** < 200 ps (typical)
- **Skew between star-hub synchronized cards:** TBD

**Connectors**

- **Analog:** SMB male (one for each single-ended input/output)
- **Trigger Input:** SMB male
- **Clock Input:** SMB male
- **Standard Multi Purpose I/O:** HAXF female (4 lines)
- **Option M2p.xxxx-DigSMB:** on extra bracket SMB male
- **Option M2p.xxxx-DigFX2:** on extra bracket 40-pole half pitch (Hirose FX2)
- **Cable Type:** Cab-3f-xx-xx, Cab-1m-xx-xx, Cab-d40-xx-xx
Environmental and Physical Details

- **Dimension (Single Card M2p.65x3 or 65x8)**: 8 channel AWG, 168 mm (½ PCIe length) x 107 mm x 30 mm (double slot width)
- **Dimension (all other single cards)**: 168 mm (½ PCIe length) x 107 mm x 20 mm (single slot width)
- **Dimension (Card with -SH6tm or -SH16tm installed)**: 168 mm (½ PCIe length) x 107 mm x 40 mm (double slot width)
- **Dimension (Card with -SH6ex or -SH16ex installed)**: 245 mm (¾ PCIe length) x 107 mm x 20 mm (single slot width)
- **Weight (M2p.59xx series)**: maximum 215 g
- **Weight (M2p.65x1, M2p.65x6 series)**: maximum 195 g
- **Weight (M2p.65x3, M2p.65x8 series)**: maximum 305 g
- **Weight (Star-Hub Option -SH6ex, -SH16tm)** including 6 sync cables: 65 g
- **Weight (Star-Hub Option -SH16ex, -SH16tm)** including 16 sync cables: 90 g
- **Warm up time**: 10 minutes
- **Operating temperature**: 0 °C to 40 °C
- **Storage temperature**: -10 °C to 70 °C
- **Humidity**: 10% to 90%

PCI Express specific details

- **PCIe slot type**
  - x4, Generation 1
  - x4, x8, x16
- **PCIe slot compatibility (physical)**
  - x4, x8, x16
- **Sustained streaming mode (Card-to-System: M2p.59xx)**
  - > 700 MB/s (measured with a chipset supporting a TLP size of 256 bytes, using PCIe x4 Gen1)
- **Sustained streaming mode (System-to-Card: M2p.65xx)**
  - > 700 MB/s (measured with a chipset supporting a TLP size of 256 bytes, using PCIe x4 Gen1)

Certification, Compliance, Warranty

- **EMC Immunity**: Compliant with CE Mark
- **EMC Emission**: Compliant with CE Mark
- **Product warranty**: 5 years starting with the day of delivery
- **Software and firmware updates**: Life-time, free of charge

Power Consumption

<table>
<thead>
<tr>
<th>Model</th>
<th>3.3V</th>
<th>12V</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2p.5530-x4</td>
<td>0.1 A</td>
<td>TBD A</td>
<td>TBD W</td>
</tr>
<tr>
<td>M2p.5531-x4</td>
<td>0.1 A</td>
<td>TBD A</td>
<td>TBD W</td>
</tr>
<tr>
<td>M2p.5533-x4</td>
<td>0.1 A</td>
<td>TBD A</td>
<td>TBD W</td>
</tr>
<tr>
<td>M2p.5560-x4</td>
<td>0.1 A</td>
<td>TBD A</td>
<td>TBD W</td>
</tr>
<tr>
<td>M2p.5561-x4</td>
<td>0.1 A</td>
<td>TBD A</td>
<td>TBD W</td>
</tr>
<tr>
<td>M2p.5566-x4</td>
<td>0.1 A</td>
<td>TBD A</td>
<td>TBD W</td>
</tr>
<tr>
<td>M2p.5568-x4</td>
<td>0.1 A</td>
<td>TBD A</td>
<td>TBD W</td>
</tr>
</tbody>
</table>

MTBF

MTBF: TBD hours
### Clock Limitations

<table>
<thead>
<tr>
<th></th>
<th>M2p.653x</th>
<th>DNx.653.xx</th>
<th>M2p.656x</th>
<th>DNx.656.xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>max internal clock</td>
<td>40 MS/s</td>
<td>125 MS/s</td>
<td>40 MS/s</td>
<td>125 MS/s</td>
</tr>
<tr>
<td>min internal clock</td>
<td>1 kS/s</td>
<td>1 kS/s</td>
<td>128 kS/s</td>
<td>128 kS/s</td>
</tr>
<tr>
<td>max internal clock (synchronized via star-hub)</td>
<td>40 MS/s</td>
<td>125 MS/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>min internal clock (synchronized via star-hub)</td>
<td>128 kS/s</td>
<td>128 kS/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>max direct external clock</td>
<td>40 MS/s</td>
<td>125 MS/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>min direct external clock</td>
<td>DC</td>
<td>DC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Bandwidth and Filters

<table>
<thead>
<tr>
<th>Filter</th>
<th>3 dB bandwidth</th>
<th>Filter characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter 0</td>
<td>70 MHz</td>
<td>third-order Butterworth</td>
</tr>
<tr>
<td>Filter 1</td>
<td>20 MHz</td>
<td>fifth-order Butterworth</td>
</tr>
<tr>
<td>Filter 2</td>
<td>5 MHz</td>
<td>fourth-order Bessel</td>
</tr>
<tr>
<td>Filter 3</td>
<td>1 MHz</td>
<td>fourth-order Bessel</td>
</tr>
</tbody>
</table>

### Dynamic Parameters

#### M2p.653x/DNx.653.xx

<table>
<thead>
<tr>
<th>Test - Samplerate</th>
<th>Output Frequency</th>
<th>Output Level in 50 Ω</th>
<th>Used Filter</th>
<th>NSD (typ)</th>
<th>SNR (typ)</th>
<th>THD (typ)</th>
<th>SINAD (typ)</th>
<th>SFDR (typ), excl harm.</th>
<th>ENOB (SINAD)</th>
<th>ENOB (SNR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 MS/s</td>
<td>800 kHz</td>
<td>±900mV</td>
<td>1 MHz</td>
<td>-142 dBm/Hz</td>
<td>90.7 dB</td>
<td>-74.0 dB</td>
<td>73.9 dB</td>
<td>97.0 dB</td>
<td>12.0</td>
<td>14.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±3000mV</td>
<td>5 MHz</td>
<td>-132 dBm/Hz</td>
<td>91.1 dB</td>
<td>-84.1 dB</td>
<td>73.9 dB</td>
<td>95.0 dB</td>
<td>12.0</td>
<td>14.8</td>
</tr>
</tbody>
</table>

#### M2p.656x/DNx.656.xx

<table>
<thead>
<tr>
<th>Test - Samplerate</th>
<th>Output Frequency</th>
<th>Output Level in 50 Ω</th>
<th>Used Filter</th>
<th>NSD (typ)</th>
<th>SNR (typ)</th>
<th>THD (typ)</th>
<th>SINAD (typ)</th>
<th>SFDR (typ), excl harm.</th>
<th>ENOB (SINAD)</th>
<th>ENOB (SNR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 MS/s</td>
<td>800 kHz</td>
<td>±900mV</td>
<td>1 MHz</td>
<td>-142 dBm/Hz</td>
<td>90.7 dB</td>
<td>-74.0 dB</td>
<td>73.9 dB</td>
<td>97.0 dB</td>
<td>12.0</td>
<td>14.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±3000mV</td>
<td>5 MHz</td>
<td>-132 dBm/Hz</td>
<td>91.1 dB</td>
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<td>73.9 dB</td>
<td>95.0 dB</td>
<td>12.0</td>
<td>14.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±900mV</td>
<td>1 MHz</td>
<td>-142 dBm/Hz</td>
<td>83.7 dB</td>
<td>-70.5 dB</td>
<td>69.8 dB</td>
<td>88.0 dB</td>
<td>11.3</td>
<td>13.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±3000mV</td>
<td>5 MHz</td>
<td>-132 dBm/Hz</td>
<td>69.8 dB</td>
<td>-70.5 dB</td>
<td>69.8 dB</td>
<td>88.0 dB</td>
<td>11.3</td>
<td>13.6</td>
</tr>
</tbody>
</table>

### Notes

- THD and SFDR are measured at the given output level and 50 Ohm termination with a high resolution M3i.4860/M4i.4450-x8 data acquisition card and are calculated from the spectrum. Noise Spectral Density is measured with built-in calculation from an HP E4401B Spectrum Analyzer. All available D/A channels are activated for the tests. SNR and SFDR figures may differ depending on the quality of the used PC. NSD = Noise Spectral Density, THD = Total Harmonic Distortion, SFDR = Spurious Free Dynamic Range.
Order Information

The card is delivered with 512 MSample on-board memory and supports standard replay, FIFO replay (streaming), Multiple Replay, Gated Replay, Continuous Replay (Loop), Single-Restart as well as Sequence. Operating system drivers for Windows/Linux 32 bit and 64 bit, examples for C/C++, LabVIEW (Windows), MATLAB (Windows and Linux), LabWindows/CVI, IVI,.NET, Delphi, Java, Python and a Base license of the measurement software SBench 6 are included.

Adapter cables are not included. Please order separately!

### PCI Express x4

<table>
<thead>
<tr>
<th>Order no.</th>
<th>D/A Resolution</th>
<th>Standard mem</th>
<th>Single-Ended Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2p.6530-x4</td>
<td>16 Bit</td>
<td>512 MSample</td>
<td>1 channel</td>
</tr>
<tr>
<td>M2p.6531-x4</td>
<td>16 Bit</td>
<td>512 MSample</td>
<td>2 channels</td>
</tr>
<tr>
<td>M2p.6532-x4</td>
<td>16 Bit</td>
<td>512 MSample</td>
<td>4 channels</td>
</tr>
<tr>
<td>M2p.6533-x4</td>
<td>16 Bit</td>
<td>512 MSample</td>
<td>8 channels</td>
</tr>
<tr>
<td>M2p.6560-x4</td>
<td>16 Bit</td>
<td>512 MSample</td>
<td>1 channel</td>
</tr>
<tr>
<td>M2p.6561-x4</td>
<td>16 Bit</td>
<td>512 MSample</td>
<td>2 channels</td>
</tr>
<tr>
<td>M2p.6566-x4</td>
<td>16 Bit</td>
<td>512 MSample</td>
<td>4 channels</td>
</tr>
<tr>
<td>M2p.6568-x4</td>
<td>16 Bit</td>
<td>512 MSample</td>
<td>8 channels</td>
</tr>
</tbody>
</table>

### Options

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2p.xxxx-SH6ex (1)</td>
<td>Synchronization Star-Hub for up to 6 cards incl. cables, only one slot width, card length 245 mm</td>
</tr>
<tr>
<td>M2p.xxxx-SH6tm (1)</td>
<td>Synchronization Star-Hub for up to 6 cards incl. cables, two slots width, standard card length</td>
</tr>
<tr>
<td>M2p.xxxx-SH16ex (1)</td>
<td>Synchronization Star-Hub for up to 16 cards incl. cables, only one slot width, card length 245 mm</td>
</tr>
<tr>
<td>M2p.xxxx-SH16tm (1)</td>
<td>Synchronization Star-Hub for up to 16 cards incl. cables, two slots width, standard card length</td>
</tr>
<tr>
<td>M2p.xxxx-DigFX2 (1)</td>
<td>16 additional multi-purpose I/O lines on separate slot bracket, FX2 connector</td>
</tr>
<tr>
<td>M2p.xxxx-DigSMB (1)</td>
<td>16 additional multi-purpose I/O lines, 10 on separate slot bracket, 6 internal connectors</td>
</tr>
</tbody>
</table>

### Services

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recal</td>
<td>Recalibration at Spectrum incl. calibration protocol</td>
</tr>
</tbody>
</table>

### Cables

<table>
<thead>
<tr>
<th>For Connections</th>
<th>Length</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog/Clock/Trig-In</td>
<td>80 cm</td>
<td>Cab-3f-9m-80</td>
</tr>
<tr>
<td>Analog/Clock/Trig-In</td>
<td>200 cm</td>
<td>Cab-3f-9m-200</td>
</tr>
<tr>
<td>Probes (short)</td>
<td>5 cm</td>
<td>Cab-3f-9S</td>
</tr>
<tr>
<td>Clk-Out/Trig-Out/Extra</td>
<td>80 cm</td>
<td>Cab-1m-9m-80</td>
</tr>
<tr>
<td>Clk-Out/Trig-Out/Extra</td>
<td>200 cm</td>
<td>Cab-1m-9m-200</td>
</tr>
</tbody>
</table>

### Software SBench6

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBench6</td>
<td>Base version included in delivery. Supports standard mode for one card.</td>
</tr>
<tr>
<td>SBench6-Pro</td>
<td>Professional version for one card: FIFO mode, export/import, calculation functions</td>
</tr>
<tr>
<td>SBench6-Multi</td>
<td>Option multiple cards: Needs SBench6-Pro. Handles multiple synchronized cards in one system.</td>
</tr>
</tbody>
</table>

### Software Options

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Software Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-RServer</td>
<td>Spectrum's CUDA Access for Parallel Processing - SDK for direct data transfer between Spectrum card and CUDA GPU. Includes RDMA activation and examples. Signed NDA needed for access.</td>
</tr>
<tr>
<td>SPC-SCAPP</td>
<td>Remote Server Software Package - LAN remote access for M2i/M3i/M4i/M4x/M4p cards</td>
</tr>
</tbody>
</table>

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1) Just one of the options can be installed on a card at a time.
2) Third party product with warranty differing from our export conditions. No volume rebate possible.

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Technical changes and printing errors possible

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